Sustainable agriculture

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Where global crop yields may falter next

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Reliably predicting where crop yields may stagnate in the future can offer a suite of benefits for food system sustainability.

Sustainable intensification of agriculture is essential for realizing a suite of development targets in tandem[1]. Substantial and widespread increases in food production will be the foundation for reversing eroding outcomes for food security and nutrition[2] and will be the essential underpinning for improving incomes of more than a billion people employed in agriculture globally[3]. Achieving these productivity gains on existing croplands – and in balance with available resources – is also critical for minimizing environmental impacts of human activities overall[4], for ensuring the protection of remaining forests and other natural systems – particularly in the Global South[5], and for buffering local and global food supply against rising climate variability and environmental disruptions[6]. Understanding where crop yields are – or likely will be – faltering is critical for targeting timely interventions and for ensuring that global agriculture can act as a major lever in ensuring humanity's footing in a safe and just operating space[7].

Now writing in *Nature Food*, Gerber et al.[8] advance our understanding of where current and future gains in crop productivity are most needed. The authors perform a global analysis of the evolution of yield gaps – the difference between actual and attainable yields – for ten major crops from 1975 to 2010. By assessing yield gaps through time, they are able to identify crops and regions for which there is 'steady growth' (where both attainable and actual yields are increasing), 'stalled floors' (where attainable yields have grown but actual yields have stagnated) and 'ceiling pressure' (characterized by narrowing yield gaps or stagnating attainable yields). The findings highlight multiple regions (for example, East Asia, North America and Eastern Europe) and crops (for example, rice and wheat) where current ceiling pressure portends future yield stagnation. Given the importance that these regions and crops will continue to play in meeting global food demand, this work provides both a stark warning and a real opportunity for proactive action.

Anticipating where – and for which crops – yields may be expected to falter can have important benefits for food security and resilience. In areas where subsistence or smallholder systems dominate, taking actions to either address stagnating actual and attainable yields or to ensure that both continue to steadily grow can produce benefits for both farmer incomes and household food security and nutrition. Preventing future yield stagnation in global breadbasket regions will also be critical for ensuring reliable and sufficient food supply to the world's many import-reliant countries[9]. Ensuring these sustained yield increases will also have important implications for modifying environmental sustainability across outcomes (for example, water, nutrients, land use, emissions and biodiversity), for improving farmer resilience to environmental disruptions (and avoiding knock-on environmental trade-offs (for example, see ref. 10)), and for preventing the propagation of production shocks and price spikes passed through international food trade[11]. As such, combining the findings of Gerber et al. with other spatially detailed measures of sustainability and resilience of crop production systems can aid in proactively identifying areas of multidimensional vulnerability.

Accurate and reliable crop production statistics form the foundation for numerous national and global agriculture and food security interventions and policies[12]. Among the most crucial of these statistics are long-term, spatially explicit (that is, subnational) time series on crop yields[13]. Comprehensive data of this nature are essential for gaining insights into the current status of crop production and for effectively forecasting potential risks and opportunities – as clearly demonstrated by Gerber et al. For the places and crops for which such statistics exist, this information can empower decision-makers to discern patterns and variations in crop yields and yield gaps and to subsequently strategize about feasible and targeted interventions[13]. Yet, substantial disparities in the quality and comprehensiveness of crop statistics persist globally[14] and point to worrying blind spots in our understanding of global prospects for (or obstacles to) meeting future food demand.

Sustained and coordinated efforts to ensure comprehensive and regular data gathering will be a critical foundation for measuring progress towards more sustainable and resilient crop production systems. This will underpin a more complete picture of the current state of a suite of economic, environmental and social outcomes as well as accounting for future impacts (for example, climate change), improvements (for example, yield gaps)[15] and resultant changes (for example, shifting cropping patterns)[16] – all of which are key to robust exploration of the solution space. Furthermore, anticipating where production gains and stability may be faltering is an ever-changing challenge – subject to geopolitical, economic and environmental pressures – and there is a constant need to proactively and reliably prioritize actions and interventions to appropriate areas and crops. The work by Gerber et al. represents an important next step in advancing knowledge in all of these directions.

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Competing interests

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